learned of more complex modes of organization that achieve rather surprising results.

The significance of organization for biological mechanisms was brought home in the nineteenth century by challenges from biologists who denied that mechanisms could account for the phenomena of life. These biologists, known as *vitalists*, highlighted ways in which biological systems function differently than non-biological systems. Xavier Bichat (1805) is an important example. In many respects, Bichat was pursuing a program of mechanistic explanation. He attempted to explicate the behavior of different organs of the body in terms of the tissues out of which they were constructed. He decomposed these organs into different types of tissues that varied in their operations and appealed to the operations of different tissue types to explain what different organs did. But when Bichat reached the level of tissues, he abandoned the mechanist program. This was because tissues exhibited two features which he thought defied mechanistic explanation. First, tissues are indeterministic in their response to external stimuli. In contrast, machines as he conceived them always respond the same when presented with the same stimulus. Second, they seem to resist those environmental forces that threaten them. It is relatively easy to take apart or interrupt a machine and stop its operation, but living tissues are often difficult to thwart or kill. These differences, Bichat thought, undermined any hope of providing a fully mechanist account of living tissues.

Several decades later Claude Bernard (1865) sketched a mechanistic answer to Bichat. It involved identifying principles of organization in living systems that could account for the features to which Bichat pointed. Bernard presented his answer by distinguishing two environments. The term *environment* is typically used only for the first – the external environment in which the organism as a whole lives. Bernard proposed that biologists also need to consider the local environment of each organ (mechanism) within a living organism. This he termed the *internal environment*. Component mechanisms in the living organism interact directly with this internal environment, not with the external environment. This internal environment provides a buffer between the conditions in the external environment and the local mechanisms. The various organs respond to the conditions of the internal environment, and these responses might be quite deterministic – when conditions in the internal environment differ, the organs predictably behaved differently. For example, decreased glucose levels in the blood could lead to lowered metabolic activity in somatic tissues or reliance on a different metabolite.

How did the internal environment serve as a buffer? Bernard proposed that each mechanism within the organism monitored an aspect of the internal environment and operated to maintain that feature of the internal environment